

SPECIFICATION

To All Whom It May Concern:

Be It Known That We, R. David Morris and Larry R. Carter, citizens of the United States, whose full post office addresses are 208 NW 5th Street, Fairfield, IL 62837 and RR 3, Box 344, Fairfield, IL 62837, have invented certain new and useful improvements in an

Automotive Fuel Pump Improvement

CROSS REFERENCE TO RELATED APPLICATIONS

None

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

N/A

BACKGROUND OF THE INVENTION

This invention relates to electrical fuel pumps for use in automobiles and other vehicles; and more particularly, to a slotted spring pin and slot construction for aligning and holding components of the pump stages together and which prevents cracking of pump components in which the slots are formed so to prevent failure of a pump.

Multi-stage fuel pumps for use in automotive vehicles are known in the art. The pump typically is a two-stage pump having a first and low pressure inlet stage followed by a second and high pressure outlet stage. The two pump stages, together with the electric motor driving the pump and the respective end caps in which inlet and outlet ports are formed must be accurately aligned during pump assembly in order for the pump to efficiently pump fuel from a tank to the engine in which the fuel is combusted. One way of achieving this alignment is to use screws which are inserted through holes in the respective components with a threaded end of the screw being threaded into a bore correspondingly threaded to receive the screw. An alternative approach is use of a pin inserted through bores in the pump components. The pins, which are enclosed or encapsulated within the bores formed in the parts, are compressed when the components are assembled together. Another alternative approach is use of either one or two spring clips applied to the outside perimeter of the pump components.

It has been that, over time, problems occur with each of these installations. With threaded screws, vibrations and shocks to which the pump is subjected will tend to loosen the screws. Even a slight loosening of the screws will affect pump performance since small gaps will appear between parts causing leakages which effect pumping efficiency. With pins, the vibrations and shocks to which the pins are subjected are transmitted to the portion of the parts surrounding the pins, and will cause cracks to occur about the bores in these components. This weakens these parts and can ultimately lead to their failure. With the spring clips, alignment of the components is inconsistent and can result in low fuel flow through the pump and/or high amperage failures.

The present invention is directed to a spring pin and slot construction by which proper alignment of pump components is achieved and subsequent problems caused by shock and vibrations are avoided.

BRIEF SUMMARY OF THE INVENTION

The present invention, briefly stated, is directed to a multi-stage turbine fuel pump for automotive vehicles. The fuel pump includes an inlet section through which low pressure fuel is drawn into the pump, a first pump stage and a second pump stage, and an outlet section through which high pressure fuel is discharged from the pump. Components comprising the respective first and second pump stages are aligned together by pins inserted in channels extending through the components to properly orient the parts. Each pin has a hollow, cylindrical shape with a longitudinal slot extending the length of the pin. The pins are made of a spring material, and each pin is compressed when the pump components are assembled together. The channels in each of the parts through which the pins are inserted comprise slots or pockets which open into the outer surface of the part.

This construction helps distribute forces exerted by the pins against the sidewalls of the channels when the pump is subjected to shocks and vibrations, so to prevent the parts from cracking about the area where the channels are formed, weakening the parts.

Other objects and features will be in part apparent and in part pointed out hereinafter.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

The objects of the invention are achieved as set forth in the illustrative embodiments shown in the drawings which form a part of the specification.

Fig. 1 is a perspective view of an automotive electric fuel pump incorporating the improvement of the present invention;

Figs. 2A and 2B are assembled views of the fuel pump illustrating the an open channel construction for spring pins used to align the parts;

Figs. 3A and 3B are exploded views of the fuel pump with its outer cover removed;

Figs. 4A-4D are respective perspective, end and two side views of a spring pin of the present invention for aligning components of a two-stage turbine assembly portion of the fuel pump;

Fig. 5 is a close-up view of an open channel, socket portion of one component of the turbine assembly in which one end of a spring pin is received;

Fig. 6 is a view similar to Fig. 5 with a spring pin installed;

Fig. 7 is a perspective view of the turbine assembly with spring pins installed for aligning the parts of the assembly; and,

Fig. 8 is a plan view of a port plate illustrating the channels formed therein for the spring pins.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

DETAILED DESCRIPTION OF INVENTION

The following detailed description illustrates the invention by way of example and not by way of limitation. This description will clearly enable one skilled in the art to make and use the invention, and describes several embodiments, adaptations, variations, alternatives and uses of the invention, including what I presently believe is the best mode of carrying out the invention. As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Referring to the drawings, an electric fuel pump for use with automotive vehicles is indicated generally 10. Pump 10 is a two-stage turbine pump having an inlet section 12, a fuel pumping section 14 including a first pump stage 14a and a second pump stage 14b, a housing 16 in which is housed a pump motor 17 (see Fig. 7), and an outlet section 18 in which a fuel outlet 19 is formed.

Inlet section 12 comprises an end cap 13 which is of a molded plastic material and has formed therein a fuel inlet 20 by which fuel at a low pressure is drawn into the pump from a fuel tank (not shown). Pump section 14a comprises end cap 13 and a port plate 22a. Pump section 14b includes also includes port plate 22a, and a casing 22b. The port plate and casing are each formed of a molded plastic material and are arranged in a stacked configuration with port plate 22a mounted between end cap 13 and casing 22b. Each pump section further includes an impeller, 24a, 24b respectively. The port plate and casing are

each formed with central cavities in which the respective impellers are rotatably installed, the impellers each being mounted on a shaft 26 of the pump motor 17. As shown in Figs. 3A and 3B, casing 22b is first fitted over shaft 26, then impeller 24b is mounted on the shaft. Next, an impeller drive 28 is fitted onto the shaft. Port plate 22a is then fitted over shaft 26, and impeller 24a is then mounted onto the shaft. Finally, end cap 13 is fitted onto the outer end of the shaft, the end cap having a housing 30 formed therein in which the outer end of shaft 26 is received.

Operation of a two-stage turbine pump is known in the art. Fuel is drawn into the pump through inlet 20 in end cap 13, and drawn to the first and lower pressure stage of the pump by impeller 24a. From this first stage, the fuel is drawn into the higher pressure second pump stage by impeller 24b. Port plate 22a has a flow path 23 formed therein (see Fig. 3A) by which fuel flows from the first to the second pump stage. Similarly, casing 22b has a flow path formed therein (not shown) by which high pressure fuel is directed from the second pump stage to pump outlet 19 via an outlet 21 in the casing. Tabs 31 are formed on the outer margin of casing 22b, the tabs fitting in slots 16s in housing 16 to aid in assembly of the fuel pump.

For proper and efficient operation of fuel pump 10, the various components comprising the turbine assembly need to be properly aligned and precisely fitted together.

Referring to Figs. 5-8, end cap 13, and port plate 22a, and casing 22b are held together during assembly using a pair of spring pins 32. As shown in Figs. 4A-4D, each spring pin is of a hollow, elongate cylindrical shape with a longitudinal slot 34 extending the entire length of the pin. The pins are formed of a spring material such as a spring steel. The

length of each pin is such that it extends between end cap 13, through port plate 22a, and into casing 22b. This is as shown in Figs. 2A and 2B.

Because it is important to not cause cracking in these components after the pump is assembled, the present invention includes open channels formed in the sidewall of end plate 13 and port plate 22a, and casing 22b for receiving the pins 32. In Fig. 5, an open sided pocket or recess 36 is shown to be formed in end plate 13. A similar open sided pocket or recess 38 is formed in casing 22b. Each pocket comprises a semi-circular opening formed in the outer wall of the end cap or port plate respectively, the opening extending from an inner face 40 of end cap 13, or an inner face 42 of casing 22b, into the body of the respective part. In each part, the depth of the pocket is approximately one-half the thickness of the part; while, the diameter of the pocket generally corresponds to that of the spring pin.

Port plate 22a has opposed channels 44a, 44b formed therein through which the pins 32 are inserted when fuel pump 10 is assembled. The diameter of each channel corresponds to that of the spring pin inserted through the channel. Both channels open into the outer face or sidewall of the port plate. Thus, while the channels facilitate insertion of the spring pins for accurately aligning the pump components; they encapsulate the spring pins, while the pockets 36, 38 do not encapsulate them. Channels 44a, 44b in the outer wall of port plate 22a have the advantage of allowing forces transmitted through the spring pins, when shocks and vibrations occur, to dissipate through the end cap and port plate, rather than cracking radially to the outside of the port plate. Preferably the open channels formed in end cap 13, port plate 22a, and casing 22b, for receiving the spring pins, are approximately five degrees (5°) less than being diametrically opposite each other. This facilitates correct alignment of the parts during assembly.

During manufacture of the fuel pump, the spring pins 32 are first installed in the respective channels in port plate 22a. The pins are inserted so that the ends of the pins extend from opposite sides of the port plate. Next, the various components comprising the two stages of the turbine pump are mounted on motor shaft 26. Casing 22b is first rotated until the tabs 31 formed on the outer face of the port plate align with the slots 16s in the housing 16 in which pump motor 17 is housed. Housing 16 and casing 22b are then correctly aligned. Next, impeller 24b is installed on shaft 26, with impeller drive 28 then being fitted onto the shaft. At this time, the inner ends of the spring pins 32 are inserted into the respective pockets 38 formed in the casing. Next, impeller 24a is mounted on shaft 26. End cap 13 is then rotated until the pockets 36 formed in the end cap align with the channels 44a, 44b in port plate 22a. When they are, the end cap is properly held in alignment with port plate 22a for the outer ends of the spring pins received in the pockets 36.

The spring pins are slightly compressed when they are installed in port plate 22a. During the final stages of pump assembly, when an outer shell (not shown) of pump 10 is fitted into place, the expansion force exerted by the springs against the sidewalls of the channels 44a, 44b and the slip fit of the pins with the pockets 36, 38 hold these components tightly together so to retain the proper alignment between the pump inlet, the first and second pump stages, and the pump outlet. Importantly, because the channels and pockets are open sided rather than completely enclosing and encapsulating the spring pins, forces which otherwise could damage the end cap and port plates are readily distributed through these parts and not concentrated about the channels where damage could occur.

In view of the above, it will be seen that the several objects and advantages of the present invention have been achieved and other advantageous results have been obtained.